# Cooperative New Madrid Seismic Network
# Center for Earthquake Research and Information
# The University of Memphis

USGS Award No.: 1434-HQ-98-AG-01929

Annual Project Summary: 2001

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Program Element I.1

Key Words: Seismology, Mitigation, Real-time earthquake information, Database

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## SUMMARY

This is the annual project summary for USGS Award 1434-HQ-98-AG-01929: " *Collaborative Research: The University of Memphis, Saint Louis University: The Cooperative New Madrid Seismic Network*." This agreement covers the CERI component of the CNMSN to perform network operations, and routine data processing, archiving, and dissemination for the purpose of seismic hazards evaluation and scientific studies in the New Madrid Seismic Zone. This report includes a review of station operations, technical challenges, and data processing modifications. During the reporting period (October 1, 2000 through September 30 2001) the contract was was in effect from October 1, 2000 through November 31, 2000. Thus, only the final two months of the project are reported.

CERI participates in two seismic networks, the Cooperative New Madrid Seismic Network (CNMSN) and the Southern Appalachian Cooperative Seismic Network (SACSN). Economies of scale allow us to perform development that is applicable simultaneously to both networks, and would be otherwise difficult to support. For these reasons some sections below are identical between the two reports.

## Routine Operations

The CERI component of the CNMSN operated 84 permanent short-period seismic stations for

two months in FY 2001. 72 stations are within the New Madrid Seismic Zone (NMSZ) and are all 3-component ISIS stations. The sensors are 4.5 Hz L-28 geophones attached to the gain-ranged ISIS electronics. Telemetry concerns require geographically dividing this network into three subnetworks, each with its own autonomous central processing facility (referred to as remote nodes) where triggered data files are recorded digitally. In addition to these nodes, select stations are also telemetered to a fourth node operating at The University of Memphis for rapid event processing of larger earthquakes (~1.8). The number of stations recorded at Memphis (22 channels) is limited by telemetry bandwidth. The CERI node also includes Memphis area data from 3 single component stations and 4 3-component stations. Network and station information is kept online.

A weekly summary of regional and worldwide earthquakes is faxed to approximately 100 recipients in the government and the private sector. While long-distance telephone charges for these faxes was not contained within the budget, the popularity of these reports has precluded other, less costly communications (e.g. internet). Data are also available via a finger utility, and reviewed and automated earthquake summaries are also available for events within the past six months. Various catalog searches are also supported. Psuedo-helicorder images provide a quick review of station operation and events for the previous week.

## Broadband Network

CERI also operated 9 broadband stations within the New Madrid Seismic Zone for two months during FY2001. These seismographs are Guralp CMG40T/DM16 sensors with digital telemetry to the nearest data processing node. Data are available via earthworm utilities and ISDN telephone. In addition to local and regional earthquake waveforms, data from 9 teleseismic events have been archived during October and November of 2000.

## Data Acquisition System

Four remote acquisition systems and one local system in Memphis are maintained and provide several levels of redundancy. The remote systems are PC-based *earthworm* using National Instruments 12 bit digitizers. Standard short-to-long-term ratios are employed to store triggered data streams. Additionally, a revolving continuous buffer of about 3 days provides opportunities for post-event archiving. All remote nodes include about 3 days of battery backup. The node at CERI consists of 5 computers housed in an earthquake restistant rack within a halon protected, environmentally controlled room with battery and diesel generator backup. The Memphis systems are as follows:

- PC dedicated to digitizing.
- Sun Ultra 5 for local use and local stations only
    - redundant triggered data
    - redundant revolving continuous buffer
    - automated locations
    - automated alerts via page, email, recenteqs, QDDS, and experimental CUBE
- Sun Ultra 10 for external use and stations
    - triggered data

        - revolving continuous buffer
        - automated locations
        - automated alerts to external *earthworm systems* and experimental near-real-time database
        - near-real-time data exchange with other networks
    - PC dedicated to experimental near-real-time *Oracle* database
    - Sun Ultra 5 dedicated to www services.

While links to additional networks are being established the following CNMSN data were being exchanged as of 30 November, 2000:

- CAPE Cape Girardeau, MO (operated by SLU)
    - export 16 channels to SLU,
    - record local revolving buffer and triggered data streams
- SLU Saint Louis, MO (operated by SLU)
    - import 12 channels from distributed SLU Quanterra sites,
    - export 22 channels to CERI,
    - import 15 channels from CERI,
    - record local revolving buffer and triggered data streams
- BLO, MPH, UALR Quanterrra Nodes (operated by SLU)
    - A local Sparc 5 provides an earthworm ring buffer in addition to the currently continuously saved Quanterra mini-SEED buffers. This extra capability provides real time data streams for automatic location in addition to preserving the continuously archived data stream. Currently stations with local Sparcs also provide data streams to NEIC's USNSN through a *VDL* (Virtual Data Logger) module
- NMAD New Madrid, MO (operated by CERI)
    - WAN access projected for December, 2000.
    - will export 128 channels to CERI,
    - record local revolving buffer and triggered data streams
- LNXT Lennox, TN (operated by CERI)
    - WAN access projected for December, 2000.
    - will export 120 channels to CERI,
    - record local revolving buffer and triggered data streams
- MKTA Marked Tree, AR (operated by CERI)
    - WAN access projected for December, 2000.
    - will export 100 channels to CERI
    - record local revolving buffer and triggered data streams
- CERI Memphis, TN (operated by CERI)
    - WAN access projected for December, 2000.
    - export automated locations to NEIC,
    - export automated locations to QDDS,
    - import automated locations from NEIC,
    - import automated locations from LRNC,
    - import 9 channels from distributed broadband installations,
    - will import 128, 120, and 100 channels from NMAD, LNXT, and MKTA respectively,

- import 22 channels from SLU,
- export 15 channels to SLU,
- export 28 channels to NEIC,

## Data Archive

We are nearly complete with our collection and review of all CERI catalog information. We now have parametric and arrival information for nearly all events located by CERI staff from 1974 through 1999 in a consistent, reproducible format. This project required significantly more effort than anticipated and while our original intention was not to review these events at the arrival time level of detail, flaws encountered necessitated a detailed review. While there are still obstacles to making these data generally available (e.g. some events are stored in single quarterly files, others in single event files) we have upgraded the Oracle database to the v2 schema and will populate it with the 1974-present catalog. The previous un-edited archive containing parametric information from 1974-present and other information remains available online . Waveform data are available on request via ftp for events recorded from 1996-present.

## Digital Backbone

The existing communications paths from sensors in the field to systems in Memphis have proven inadequate to provide reliable automated alerts and timely routine processing. To mitigate this situation we are combining resources from CERI, the Union Pacific Foundation, the Mid-America Earthquake Center, and the USGS to develop and install a 1.44Mbps link between Memphis and the remote processing nodes. Telemetry paths and repeater locations have been finalized and we are awaiting agreement finalization with two tower owners prior to proceeding with the installation. All necessary hardware has been acquired and we anticipate installation during the last quarter of calendar 2001.

## Automated Alerts

The earthworm based automated alert system in operation at Memphis has proven to be a valuable addition and we are considering expanding the recipient pool to users external to CERI. In order to minimize false alarms, the system is tuned such that only events with magnitude approximately greater than 2.5 are located. During the period from October 1, 2000 through November 30, 2001 the system operated as expected with no false alarms and no missed events within the parameters of the configuration.

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Non-Technical Project Summary: 2001

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